In-Operando XRD of Anode-Supported LSCF Cathodes at 700 – 800°C for 1000 h

John S. Hardy, Jared W. Templeton, Dan J. Edwards, and Jeffry W. Stevenson

Experimental Parameters for ~1000 hour tests
- Cell Tests
  - Temperatures: 700, 750, and 800°C
  - Operating Cells: Constant Current approximating 800 mV
  - Resting Cell: OCV (750°C)
  - Feed Gas: Flowing air (cathode) and moist H2 (anode)

XRD
- Repeated 1 hour scans
- Step Size: 0.02°
- Time/Step: 1.1 seconds

Typical Results & Analysis
- Various timeframes are prepared
- To identify time-dependent changes
- Summing 1000 hours of XRD scans made it possible to resolve trace phases

New SOFC Research Capability was Developed at PNNL

SUMMARY
- During sintering, Sr migrates to SDC/YSZ interface and Fe/Co spinels form.
- At 700°C and 0.8V or 750°C and OCV, the lattice parameters of Fe/Co spinels gradually change.
- At 700°C and 0.8V, at 750°C and 0.8V, Fe-Co spinels equilibrate too quickly for observation with laboratory XRD.
- SEM suggests that Fe-rich spinels are predominantly in the SDC layer.
- Co-rich spinels are predominantly in the LSCF cathode.
- Spinel lattice parameter changes suggest Fe & Co exchange with LSCF.

POST-MORTEM SEM/EDS MAPPING

Temperature Cell Voltage Time-dependent Changes in XRD

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Cell Voltage</th>
<th>Changes in XRD</th>
</tr>
</thead>
<tbody>
<tr>
<td>700°C</td>
<td>~0.8 V</td>
<td>Divergent Fe3O4 and Co3O4 peak shifts</td>
</tr>
<tr>
<td>750°C</td>
<td>OCV</td>
<td>Divergent Fe3O4 and Co3O4 peak shifts</td>
</tr>
<tr>
<td>750°C</td>
<td>~0.8 V</td>
<td>None</td>
</tr>
<tr>
<td>800°C</td>
<td>~0.8 V</td>
<td>None</td>
</tr>
</tbody>
</table>